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not seriously interfere with the quantity of water actually transferred; and a little consideration will show that the amount of such interference can be calculated with some certainty.

Nothing has been said as to the nature of a float suitable for indicating the motion in the glass pipe. Somewhat as Forel in his "plemyrameter" used corks weighted to the specific gravity of water, so here a cylinder having a diameter somewhat less than the inside diameter of the glass pipe, and having the specific gravity of water, could be used. Each of the metal ends of such cylinder should be pierced by a hole, so that the cylinder could be threaded loosely on a fine wire stretched along the axis of the small pipe. However, some other style of float may be preferable to this. The readings should be made at regular hourly or half-hour intervals.

The amount whereby the observed b, properly corrected for pipe resistance, may fall short of its simple theoretical value, *i. e.*, its value on a perfectly rigid earth devoid of oceans, is an important factor in the determination of the amount of yielding of the earth to the known tidal forces, and so in the determination of the earth's rigidity. The interpretation of such measurements, however, constitutes no part of the present communication.

R. A. HARRIS

WASHINGTON, D. C.,
March 28, 1914

[Since the above was written, I have seen the surprisingly consistent results obtained by Professor Michelson and published in the *Journal of Geology* and in the *Astrophysical Journal* for March, 1914; also the account published in SCIENCE for June 26, 1914. It will be recalled that in these determinations, the vertical oscillation of the water's surface at the two ends of a half-filled horizontal pipe was the quantity measured. R. A. H., September 29.]

APPROXIMATE MEASUREMENT OF TEXTILE FIBERS

THIS note is hardly the place for the demonstration of the following theorem. However, it is readily capable of demonstration, and the reader of a mathematical turn of mind will at once perceive the line of proof.

THEOREM. If an infinite series consisting of straight parallel linear elements of every possible length, each element arranged perpendicularly to and symmetrically to a given straight line, be bisected along that line and the two half-series thus produced be placed with the former outer edges of adjacent, then if the elements of one of the half-series be systematically rearranged, its longest element matched to the shortest of the other half-series and its next longest to the next shortest of the other half-series and so on, a new parallel-sided uniform series will be produced, each of whose elements has a length equal to the mean length of the elements of the original series.

If the theorem be changed so that the elements are stated to vary in length within prescribed limits, then for this modified theorem the line of demonstration as well as the final result is the same.

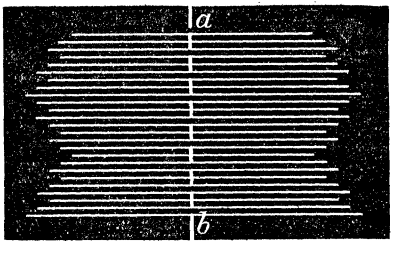

FIG. 1. Straight elements varying in length within prescribed limits, arranged symmetrically with reference to a given straight line, a–b, in accordance with theorem.

If the number of elements is limited, say, for example, to a few thousand, the result becomes approximate; and if the elements instead of having their middle points on the given straight line are arranged so that their middle points fall at random on either side of the given straight line a distance less than half the length of the shortest element, then the reconstructed series will have a width approximately equal to the mean length of the original elements; for it will always be pos-

sible to pair the elements whose middle points fall to the right with those whose middle points fall to the left in such a way, the long with the short, as to secure the result stated in the theorem approximately, the degree of approximation depending on the number of the original elements and the uniformity of their increments in length when arranged in the order of their magnitude.

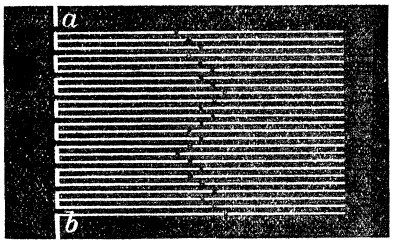

Fig. 2. Series shown in Fig. 1 bisected, and its left half transposed and turned over. For the sake of simplicity, in Fig. 1 the elements are so assorted that in Fig. 2 they match without rearrangement. The width of the second series (Fig. 2) equals the mean length of the original elements.

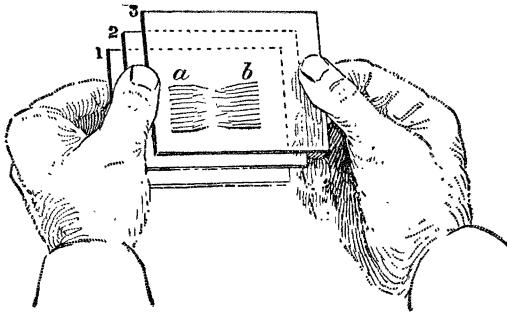

Fig. 3. Application of the theorems to the measurement of textile fibers in mass, for instance a "pull" of cotton fibers. The pull consisting of about 2,000 fibers is cut in two transversely with clean sharp shears. One half of the pull "*a*," is placed between thin glass plates, 1 and 2 (lantern plate covers). The other half is placed between the glass plates 2 and 3. 1 and 2 are pressed firmly together with the left hand, as shown, while 3 is held loosely with only its left hand edge in contact with 2 and resting against the left thumb, its right hand edge being lifted so as to enable the operator to move the fibers "*b*" back and forth over the fibers "*a*" by friction. Or the fibers "*b*" may be moved back and forth in any one of several different ways. For instance, the left edge of "3" may be used to move "*b*" back and forth on "2." When "*a*" and "*b*" are adjusted the three plates of glass are held in the left hand and the measuring scale applied with the right hand.

It has been ascertained by comparison with the results of my accurate method of measuring the length of fine crooked fibers, a description of which has already been published, that if a series of textile fibers be arranged in a manner similar to that described in the theorems, the mean length of the fibers can be measured approximately, if proper allowance be made for the "fly-back," or shortening of the fibers, due to their elasticity.

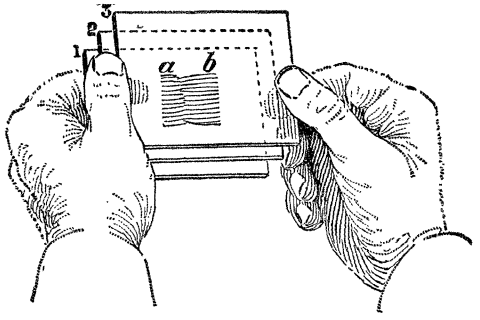

Fig. 4. The halves of the "pull" shown in Fig. 3 matched ready for measurement. The halves are adjusted against a strong transmitted light and yet with a good top-light; for instance, against sky-light reflected from a mirror laid on a table near a window; "*b*" is so adjusted over "*a*" that the fiber masses present the same shade from end to end. This simple optical method is found to approximate the conditions of the theorems. Care should be taken not to disturb the parallelism of the fibers. The width of the series, as arranged in Fig. 4, represents the mean length of the fibers minus the "fly-back." This latter, about one millimeter in twenty-five for well-conditioned cotton fibers, has to be added. The results are accurate to the fraction of a millimeter. The method is definite, readily learned, and easily applied.

It is intended to publish details in connection with this approximate method of measuring textile fibers in a separate publication.

N. A. Cobb

Bureau of Plant Industry,
Department of Agriculture,
September 25, 1914